The following is a DRAFT Cooperative Agreement Notice (CAN) to incite your comments on the formation of a NASA Astrobiology Institute (NABI). Through this CAN, multidisciplinary research teams will be selected that will constitute the membership of the NABI. The members of the institute will not be co-located but connected through the Next Generation Internet. The intent is to amplify multidisciplinary research and strengthen training in Astrobiology through interaction enabled by the Institute.

This DRAFT is not meant to represent a complete document but to announce to the research community NASA's intended Institute, including its nature and the mechanism for its creation, and to receive feedback from the community before releasing the actual Cooperative Agreement Notice soliciting proposals for membership in the Institute.

Please submit your questions and comments to the Internet at <michael.meyer@hq.nasa.gov> and put "CAN" in the subject heading. All comments and questions will be considered until 5pm EST, August 29, 1997.

All comments, questions and answers will be posted in the same directory as the draft CAN but anonymity will be maintained.

# Cooperative Agreement Notice

## SOLICITING PROPOSALS TO BECOME A MEMBER OF THE

## NASA Astrobiology Institute
## (NABI)

## TABLE OF CONTENTS

## 1.0 Introduction

This Cooperative Agreement Notice (CAN) solicits proposals to become a member of a NASA Astrobiology Institute (NABI) whose members will be selected by NASA Headquarters and operations managed by the NASA Ames Research Center (ARC). The selected members and the management will constitute the Institute. Participation in this solicitation is open to all categories of organizations, domestic and foreign, including industry, educational institutions, non profit organizations, NASA centers, and other Government agencies. If partnerships or cooperative arrangements are proposed, a lead organization submits the proposal.

The primary purpose of the NABI is to enable world-class multidisciplinary research in Astrobiology. The NABI will also coordinate and catalyze Astrobiology research across a range of science disciplines and organizations, develop and demonstrate modern communications technologies in support of multidisciplinary research, provide scientific and technical guidance on the Astrobiology aspects of current and future NASA missions, participate in training students at the college and graduate levels, lead in developing a K-12 education program focused on Astrobiology, and provide outreach to the general public. A defining characteristic of the research done by the NABI will be the formation of interdisciplinary teams of researchers to attack major questions in Astrobiology across a broad scientific front.

The NABI will be a nontraditional Institute in the sense that its elements or members will be geographically dispersed. The members themselves propose and carry out the multidisciplinary research but will gain access to expertise in diverse fields through NABI. This structure may be necessary to ensure that the NABI has the breadth and talent to address the range of fundamental questions inherent in Astrobiology. Accordingly, the universities, NASA centers, and other research entities that will make up the Institute will be tied together by the Next Generation Internet (NGI - see Appendix A); by frequent personnel exchanges; by an ongoing series of workshops, seminars, and courses; and by sharing common research interests.

The concept for this Institute is relatively new and is, by necessity, experimental. NASA's goal for the Institute--and one of the Institute's principal challenges--will be to use the tools and activities mentioned above, together with others as appropriate, to establish a close and scientifically productive interaction among its members, even though they are geographically separated. Achieving this goal will take time, and it is to be expected that the scope and nature of the Institute will evolve over the first few years.

Institute membership will be based on a competitive peer reviewed selection process that will be open to the research community, in general. Different levels of membership are envisioned as described below, corresponding to the research, the scope of proposed participation, and commitment of resources on the part of the proposing organization.

It is intended that the research enabled by the Institute will complement the programs carried out by individual Principal Investigators in the Exobiology, Evolutionary Biology (a new program to begin in FY 1998), and other NASA grants programs relevant to Astrobiology.

Note: This CAN is released as a draft to invite comments from the research community. Please submit your questions and comments to the Internet at <michael.meyer@hq.nasa.gov> and put "CAN" in the subject heading. All questions and answers will be posted but anonymity will be maintained.

## 2.0 Background and Science Scope

Astrobiology, as included in the NASA Strategic Plan, is defined as the study of life in the universe, providing a scientific foundation for the multidisciplinary study of the origin and distribution of life, including the role of physical forces, planetary atmospheres, and ecosystem interactions in the evolution of living systems. Many elements of NASA's current science and exploration program fall wholly or partly within this broadly defined area of science. These include aspects of three of NASA's Strategic Enterprises: Space Science, Mission to Planet Earth, and the Human Exploration and Development of Space. NASA's Astrobiology Program provides the scientific basis for coordinating these activities to maximize our progress in understanding life's origin, evolution, distribution, and future in the universe.

Recent discoveries have stimulated widespread excitement in Astrobiology. These include the accumulating evidence for the ability of terrestrial organisms to thrive in a wide variety of extreme environments on Earth, together with the discovery in the past year of planets orbiting other stars and of potential evidence for fossils in a Martian meteorite. NASA will initiate a new program, Astrophysical Search for Origins, with emphasis on the search for Earth-like planets beyond the solar system and an understanding of the origin and distribution of life in the universe. NASA's program in Astrobiology has substantial overlap with the Origins program, and extends beyond it to encompass questions dealing with the adaptability of terrestrial biology to nonterrestrial environments and the development and evolution of ecologies and their interaction with their changing environments, especially when those changes are rapid. Program information, such as the NASA Strategic Plan and Astrophysical Search for Origins, can be found through the OSS home page <http://www.hq.nasa.gov/office/oss/>.

The following general questions exemplify the breadth and depth of Astrobiology:

* How do habitable worlds form and how do they evolve?

* How did living systems emerge?

* How can other biospheres be recognized?

* How have the Earth and its biosphere influenced each other over time?

* How do rapid changes in the environment affect emergent ecosystem properties and their evolution?

* What is the potential for survival and biological evolution beyond their planet of origin?

## 2.1 Sample Research Topics

Clearly, the breadth of Astrobiology is such that single research projects can not possibly encompass the entire program. The research concepts described below offer examples of representative multidisciplinary topics appropriate for research by members of the NABI. These concepts are not meant to be exclusive but to convey the scope and breadth of member projects, as well as the integration of the various disciplines required to pursue them successfully. Although substantial effort will naturally be directed towards understanding the origin and development of life on Earth (currently our only known example) NASA's goal is to develop an understanding of whether there is life elsewhere, where life could be found, how best to detect it, and what issues are associated with adaptation and evolution of terrestrial organisms to other environments.

Each of the examples given below is complex enough to warrant the involvement of multiple investigators from different scientific disciplines, and frequent interaction with colleagues through the NGI are expected to be highly beneficial

- What constitutes a habitable environment? What physical and biological processes control the formation and survival of habitable planets around single star or binary star systems? What features are key for recognizing habitable planetary systems? What Earth observations can contribute to our understanding of habitability and detectability.

- What was the inventory of organic material on the prebiotic Earth and what were the relative contributions of terrestrial and extraterrestrial sources?

- What are the processes of self-organization that led to the formation of membranes and the emergence of metabolism, catalysis and replication? Is self-organization into auto-catalytic, evolving systems a robust event or, alternatively, is it characteristic of only specific suites of chemicals and narrow ranges of environmental conditions?

- How could basic cellular functions, such as energy capture, chemical catalysis, and transport of organic material across cell boundaries have been accomplished under protobiotic conditions? Using a combination of experimental and theoretical efforts, how can one create versions of cellular, self-reproducing, and evolving systems?

- How does the phylogenetic and geologic record shed light on the nature of the Earth's environment and on the adaptations of the early biosphere to changing environmental conditions? What were the characteristics of the common ancestor(s) of modern life? What were the characteristics of even earlier life? How have the biogeochemical cycles of the biogenic elements changed during Earth’s entire history? What features of the early (preoxygenic?) Earth’s atmosphere would be indicators of life on the ancient planet, and what aspects would be shared by other inhabited planets?

- How have physical factors, including gravity, influenced speciation? Is gravity necessary for life as we know it? How might gravity levels above or below that found on Earth influence survival, adaptation, and evolution?

- How do cellular processes evolve and how have they come to differ among species? What are the mechanisms of cellular change that lead to natural selection? How do groups of cells evolve to achieve partial independence from other groups of cells and develop strategies for pattern generation? How are genetic differences in populations selected to lead to evolutionary changes? How do genetic changes produces phenotypic changes?

- Are there properties or characteristics of life that are universal and measurable? What key biological markers can be used to expand current capabilities to detect evidence of life in terrestrial fossils and may these be useful for analyzing extraterrestrial material?

Workshop reports that may provide useful background information are: Blue Dot Workshop, held at the Ames Research Center on June 27-28, 1996, and the Astrobiology Workshop, held at Ames on September, 9-11, 1996, and available on the Internet at <http://astrobiology.arc.nasa.gov/>.

Reports are available in hard copy from

Dr. Lawrence Caroff
Mail Stop 239-160
Ames Research Center
National Aeronautics and Space Administration
Moffett Field, CA 94035-1000
(415) 604-1545
lcaroff@mail.arc.nasa.gov

## 3.0 General Scope and Activities of the Institute

ARC, in partnership with other research organizations, will establish a NABI to promote research in Astrobiology, with emphasis on multidisciplinary team efforts directed at major questions. The Institute will exploit modern communications and information technology to bind together institutions and research teams in geographically separated locales to enable an unprecedented degree of interaction of remotely located participants to pursue common research goals.

The Institute will draw its strength both from the cadre of experienced researchers at all the member institutions and from an active core of beginning scientists--students, postdoctoral fellows, and junior faculty--who will work together and train together and develop innovative ways to cooperate and collaborate, including extensive use of the communication networks of the 21st century. Ames anticipates hosting many group activities but is open to proposals from Institute members.

An Institute-wide postdoctoral program will be established by the NABI, with fellowships available to promising candidates who wish to work with one or more of the member institutions on appropriate research. Funding for successful candidates will be independent of the host institution, and they will be encouraged to work closely with more than one host institution as appropriate to pursue their research interests.

Excellence in multidisciplinary research will be the first priority of the Institute. However, NASA will also expect the Institute, once established, to lead in identifying and developing new program directions and mission and technology requirements; in the coordination, integration, and communication of multidiscipline and multiorganizational contributions; in the development of a new generation of astrobiologists; and to capitalize on the great public appeal of Astrobiology by building an education and outreach program to share the excitement of discovery with the people who pay for it.

A high priority activity of the Institute will be to provide a forum for the exchange and development of ideas in Astrobiology. To this end, the Institute will lead an annual integration workshop composed of NASA scientists, university scientists, and others to identify the current state of knowledge in the disciplines relevant to Astrobiology and to initiate discussions of interesting new research directions stimulated by workshop reports. In collaboration with the Astrobiology community and NASA Headquarters, the NABI will select a subset of these research areas and organize focused workshops in them. These activities will provide useful input to NASA Headquarters for establishing funding priorities, developing solicitation announcements, initiating technology developments, and determining mission requirements.

The scope and nature of the Institute will evolve over time and in cooperation with the members.

However, in order to fulfill its primary role of enabling multidisciplinary research between members, as a minimum, the Institute's activities are expected to include:

- Encouraging frequent scientific interchange among Institute members.
- Fostering exchanges of scientists at all levels between the member institutions.
- Helping to coordinate undergraduate and graduate cross-training programs which will allow students in one discipline area of Astrobiology to study and work in another allied discipline, thus training a new generation of multidisciplinary scientists. Part of this effort may include summer schools for undergraduate and graduate students.
- Organizing and coordinating seminars and workshops, including those that will utilize the NGI to link the member NABI institutions; offering courses in Astrobiology through the NGI, drawing on the broad range of expertise across the membership to set up and teach the classes and establish a new course of study; and organizing workshops to determine the need and establish priorities for national facilities for Astrobiology research.
- Exploring the technology of the Next Generation Internet as a tool for conducting research and fostering scientific exchange.

Ames Research Center has been designated as NASA's Center of Excellence in Information Technology. Accordingly, ARC has the lead in NASA for a multiagency effort to develop the Next Generation Internet, which is expected to provide up to several orders-of-magnitude increase in throughput over the existing science Internet. The Institute will serve as a "Beta Test Site"' for the NGI, especially focused on the interface between the user and the NGI "pipeline," working closely with specialists in information science to realize the full potential of the NGI in a challenging research environment. This goal will include exploiting the NGI to provide remote access to experimental facilities for researchers at a variety of institutions.

## 4.0 Structure of the NASA Astrobiology Institute and Roles of Members

Each member of the Institute is expected to: actively pursue its peer-reviewed selected research program; participate actively in Institute activities such as workshops, seminars, classes, training, and education and public outreach; and work to continuously improve the effectiveness of the intermember connections and collaborations. Although much of the interaction is expected to take place through communications linkages, XX number of trips per year to the San Francisco Bay area should be budgeted.

ARC will house the Institute's Director's office and staff, and take responsibility for: coordinating activities; disbursing funds, including a small Director's Discretionary Fund for high-risk/high-payoff research projects; administering the NABI postdoctoral fellowship program; organizing and leading workshops; coordinating the Institutes' programs in education and public outreach; and expediting NGI hookups and developing the interfaces between the scientists and the network.

The Director will form an Executive Council, made up of delegates from the member institutions, which will be the principal technical guiding body of the Institute.

An independent outside visiting committee, reporting to the Ames Center Director and to the Associate Administrators at NASA Headquarters for Space Science, Mission to Planet Earth, and Human Exploration and Development of Space, will periodically review and evaluate the performance of the Institute.

## 5.0 Scope of Proposals

Proposals (see Appendix B) will be evaluated on their merits, based on the evaluation criteria given in Section 6.0.

The size of award will depend on the scope of the proposal and the proposed level of visible, long-term institutional commitment to Astrobiology and to the NABI. Proposals will be entertained which range in scope from:

– a multidisciplinary team attacking a major science question(s) within the context of existing staff and organizational structure, to

– a new multidisciplinary organizational unit (e.g. “Center for Astrobiology Studies”) and/or a new academic department, including the addition of new tenured (or tenure-track) faculty positions, including one or more research teams attacking a range of major science questions in Astrobiology.

It is expected that headquarters will select several multidisciplinary teams and only one or two of the more involved organizational units. Proposers should recognize that NASA’s Institute budgets are not fully approved and are expected to increase in the coming years. Therefore, proposals may include a graduated or phased program that ramps up to a steady state over one or more years.

Where appropriate, proposals will be considered which propose a direct involvement with NASA astrobiologists -- including for example: sharing of graduate and undergraduate students, opportunities for teaching courses in Astrobiology, faculty appointments, sharing of experimental facilities, and tightly coordinated research programs. (Note: Multidisciplinary team proposals are ones that, because of their size and/or because they cross the boundaries of established NASA grants programs, could not be expected to receive funds through specific discipline grants programs.)

## 6.0 Proposal Evaluation Criteria and Selection Procedures

In order of priority, the criteria for evaluation for this CAN are:

1. (a) Scientific and technical merit of the proposed research program, and the likelihood that substantial progress can be made during the proposed duration of the effort. Also: scientific breadth of the proposed research, plans for coordination of the various established science disciplines proposed to accomplish the research, and quality of proposer’s staff.

   (b) Proposed use of modern information technology, exchange of personnel, and/or other innovative means of interaction to strengthen the ties among members of the Institute and increase its overall scientific productivity.

   (c) Proposed level and quality of long term commitment of the proposing research organization to the Institute and to the emerging field of Astrobiology.

2. Relevance to NASA’s program in Astrobiology.

3. Realism and total amount of the proposed cost.

4. Training, K-12 education, and public outreach programs.

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In making the selection, NASA will also consider overall program diversity and balance in order to cover as wide a variety of scientific questions as is practical and to incorporate a range of level of home institutional involvement of members in the Institute, as described in section 5.0.

The evaluation of the proposals will be conducted by a peer review panel. Those requests that most clearly meet the criteria outlined above, as judged by the peer panel, will be recommended to the selecting official(s).

## 7.0 Budget and Duration of Agreements

In fiscal year 1998, we expect $4-6M will be available in this competition for Institute membership and NASA expects to be able to select 5-10 proposals. Furthermore, it is expected that the NABI budget to ramp up to $15M beginning in fiscal year 2000, which, besides direct member funding, would also including funding for administration, management support, workshops, and training programs at Ames Research Center. Proposals may pose a graduated involvement and may be submitted for up to five years duration, with opportunities to propose for renewal periods of five years each. The research activities will be reviewed at least every three years as required by Federal regulations. Duration of this Institute Program is expected to be at least 20 years. NASA may elect to select all or part of a successful proposal. In case one or more of the proposals received in response to this solicitation is deemed meritorious of funding, but in need of greater definition, NASA reserves the right to provide interim funding for its/their further development, with the understanding that a revised proposal will be submitted for independent peer review at a time to be determined in the negotiation for the cooperative agreement. An additional CAN may be issued in FY 2000 or later to solicit new members.

## 8.0 Resource Arrangements

Except as provided below, Cooperative Agreements in accordance with regulations CFR Part 1260 for educational and nonprofit institutions and 14 CFR part 1274 for commercial organizations (see "Grant and Cooperative Agreement Handbook, NPG 5800.1D, available at <http://procure.msfc.nasa.gov/grcover.htm>) will be used as funding instruments for the Astrobiology Institute.
Specific resource arrangements established under this notice may vary depending on the nature of the Principal Investigator's home organization. Arrangements will include:

Institutions of Higher Education, Nonprofit Organizations, and State and Local Government. For universities, nonprofit organizations, and state and local governments, cooperative agreements will be negotiated.

For-Profit Organizations. In the case of for-profit organizations, Cooperative Agreements will be negotiated with cost-sharing requirements. The total NASA contribution to the Cooperative Agreement will depend on the contribution by the for-profit project team, but will in no event exceed 50% of the total project value. Note that no profits or fees are allowable or payable under Cooperative Agreements.

To the extent that a for-profit organization teams with an institution of higher education, nonprofit organization, or state or local government, the for-profit organization is expected to provide at least 50% of the costs of its own participation.

National Laboratories. For successful proposers from National laboratories (not including Civil Service or Military staff laboratories, but only Government-Owned, Contractor-Operated laboratories), necessary resources will be provided via an interagency funds transfer and documented under a memorandum of agreement between the sponsoring organization and NASA.

Other Agency Laboratories. Non-NASA Government Owned-Government Operated laboratory personnel may propose in response to this CAN. For such participants, necessary resources will be provided via an interagency funds transfer and will be documented using a memorandum of agreement between the other agency laboratory and NASA. Negotiated project resources may be used to cover direct project costs.

NASA Centers

(a) NASA personnel may be part of a proposing team. The portion of NASA involvement will be delineated in the negotiated cooperative agreement as part of NASA's responsibilities. The costs of NASA participation will be funded using NASA's internal funding procedures and not identified as a cost under the cooperative agreement. However, the cost associated with NASA participation, using currently specified requirements for full cost accounting, should be included in the total cost of the proposal for evaluation purposes.

(b) NASA-led proposals may be submitted in response to this solicitation. For successful proposers within NASA, the necessary resources will be provided via NASA's internal funding procedures. If researchers from other institutions are included on a successful NASA-led proposal, then the necessary resources will be provided through the funding mechanisms given above, as appropriate.

Guidelines for Non-U.S. Participation

NASA welcomes proposals from outside the U.S. However, investigators working outside the U.S. are not eligible for funding from NASA. Proposals from non-U.S. entities should not include a cost plan. Proposals from outside the U.S. and U.S. proposals that include non-U.S. participation, must be endorsed by the respective government agency or funding/sponsoring institution in that country from which the non-U. S. participant is proposing. Such endorsement should indicate that the proposal merits careful consideration by NASA, and if the proposal is selected, sufficient funds will be made available to undertake the activity as proposed.

In addition to sending the required number of copies of the proposals to the designated address, one copy of the proposal, along with a Letter of Endorsement from the sponsoring non-U.S. agency, must be forwarded to:

Ms. Bettye Jones
(CAN 97-XXXX)
International Science and Aeronautics Division
Code IS
NASA Headquarters
Washington, DC 20546-0001
USA

All proposals must be typewritten in English. All non-U.S. proposals will undergo the same evaluation and selection process as those originating in the U.S. All proposals must be received before the established closing date; those received after the closing date will be held for the next proposal cycle. Sponsoring non-U.S. agencies may, in exceptional situations, forward a proposal without endorsement to the above address if endorsement is not possible before the announced closing date. In such cases, however, NASA's International Science and Aeronautics Division should be advised when a decision on endorsement can be expected.

Successful and unsuccessful proposers will be contacted directly by the NASA Research Program Management Division. Copies of these letters will be sent to the sponsoring government agency. Should a non-U.S. proposal or a U.S. proposal with non-U.S. participation be selected, NASA's International Science and Aeronautics Division will arrange with the non-U.S. sponsoring agency for the proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail:

1. a letter of notification by NASA; and
2. an exchange of letters between NASA and the sponsoring governmental agency, or
3. a formal Agency-to-Agency Memorandum of Understanding (MOU)

## 9.0 Schedule

This CAN is by NASA Headquarters, which will also be responsible for proposal evaluation and selection. The selection official for this solicitation will be **TBD**. Ames Research Center will negotiate Cooperative Agreements with successful proposing institutions and will administer all funding. Table 1 summarizes key milestone dates for proposal submission and agreements awarded.

Table 1

| | |
|---|---|
| Preproposal workshop | August 27, 1997 |
| Comment Due Date | August 29,1997 |
| CAN release | September 1997 |
| Letters of Intent due | October 1997 |
| Proposals due | December 1997 |
| Selection target | January 1998 |
| Cooperative Agreements awarded | February 1998 |

APPENDIX A

This appendix is included to give the proposer background on the Next Generation Internet - a multiagency partnership to develop much higher performance networking systems. Because of the multiagency structure, universities applying to the Astrobiology CAN must also propose to the NSF High Performance Connections Program.



## Next Generation Internet

The Next Generation Internet (NGI) initiative is a multiagency partnership with industry and academia to develop significantly higher performance networking systems enabling next-generation distributed applications between scientists, engineers, and computing resources. The main goal of the program is to assure U.S. technological leadership in communications through research and development that advances the leading edge of networking technologies and services.

Specifically, the NGI has three goals as outlined in the NGI Concept Paper (see ***http://www.ngi.gov***):

1. Promote experimentation with the next generation of networking technologies.
2. Develop a next generation network testbed to connect universities and Federal research institutions at rates that are sufficient to demonstrate new networking technologies and support future research.
3. Demonstrate new applications that meet important national goals and missions.

To achieve these goals, NGI will be built on the base of current Research & Development activities and programs in the participating Federal agencies. Furthermore, it will call on substantial matching funds from its private sector partners and collaborate with academia.

### Goal 1: Experimental Research for Advanced Network Technologies

Goal 1 activities will focus on research, development, deployment, and demonstration of the technologies necessary to permit the effective, robust, and secure management, provisioning, and end-to-end delivery of differentiated service classes. These activities cluster into three major tasks: network growth engineering, end-to-end quality-of-service (QoS), and security.

Although the high-speed and advanced communications capacity (developed under goals 2.1 and 2.2) will enable advanced applications for the Department of Defense (DoD), the Department of Energy (DoE), the National Aeronautics and Space Administration (NASA), the National Science Foundation (NSF), and other agency users, increased bandwidth alone will be insufficient to meet the dependability, various classes of services, security, and real-time demands of emerging and next-generation applications, such as collaboration, wide area distributed computing, and teleoperation and control. The challenge for goal 1, then, is to ensure that the advanced capabilities of goal 2 networks can be made predictably and reliably accessible to a broad spectrum of users sharing a common infrastructure. This will involve goal 1 technologies being developed and aggressively deployed into the goal 2.1 networks. Therefore, applications must realize and plan for those instances when the goal 2.1 infrastructure may suffer temporary degradation of service as a result of the experimental alpha deployment of goal 1 technologies and goal 3's use of these technologies.

This will be joint agency effort with the Defense Advanced Research Projects Agency (DARPA) as the lead and participation by DoE, the National Institute of Standards and Technology (NIST), NASA, NSF, and other agencies.

### Goal 2: Next Generation Network Fabric

The networks developed under the NGI initiative will connect at least 100 sites—universities, Federal research institutions, and other research partners—at speeds 100 times faster than today's Internet, and will connect on the order of 10 sites at speeds 1,000 times faster than the current Internet.

This goal addresses end-to-end connectivity (to the workstation) at speeds from 100+ million bits per second (Mbps) up to 1+ billion bits per second (Gbps.) Although some networks have already achieved OC-12 speeds (622 Mbps) on their backbone links and some experimental links are running at 1+ Gbps, end-to-end usable connectivity is typically limited to less than 10 Mbps because of bottlenecks or incompatibilities in switches, routers, local area networks, and workstations. Goal 2 addresses these shortcomings by developments and demonstrations involving two subgoals.

#### *Subgoal 2.1: High-Performance Connectivity*

The goal 2.1 demonstration network fabric will function as a distributed laboratory. It will deliver a minimum of 100 times or greater improvement over the current Internet performance on an end-to-end basis to at least 100 interconnected NGI-participating universities, national laboratories, and Federal research sites demonstrating research and other important applications that require such an infrastructure. This network fabric will be large enough to provide a full-system, proof-of-concept testbed for hardware, software, protocols, security, and network management that is required in the commercial Next Generation Internet.

This goal will address not only accessible but also remote sites and Experimental Program to Stimulate Competitive Research (EPSCoR) states. Experiments are anticipated to assist research in reaching beyond the current Internet infrastructure.

Goal 2.1 is a joint agency effort led by DoE, NSF, and NASA, with participation from DoD and other agencies.

### *Subgoal 2.2: Next Generation Network Technologies and Ultra-High Performance Connectivity*

Goal 2.2 addresses the development of ultra-high speed switching and transmission technologies and of end-to-end network connectivity at 1+ Gbps. Because of its high risk and pioneering nature, networks involved will be initially limited to approximately ten NGI sites and a limited number of applications will be implemented. Some of the nodes of goal 2.2 will overlap with those of goal 2.1.

Attaining this goal, together with the technologies developed in goal 1, will be the pathway to terabit per second (Tbps) networks, operated by the appropriate network management and control with guaranteed end-to-end quality-of-service. Partnering with industry is the key to a shared infrastructure that can be used profitably to support high-end scientific users and large numbers of ordinary commercial users.

Goal 2.2 is a joint agency effort with DARPA as the lead, and participation from DoE, NASA, NSF, and other Government agencies.

### Goal 3: Revolutionary Applications

To achieve goal 3, the participating Federal agencies established procedures to identify appropriate applications to be tested. These applications require the advanced capabilities of goals 1 and 2. Furthermore, the agencies must be willing to adapt their applications to take advantage of these advanced networking capabilities. The resulting NGI applications will integrate advanced networking and application technologies.

A coordinated selection process will be used to ensure that applications tested and demonstrated on the NGI network(s) provide robust, realistic, complete tests of technologies that are extensible and adaptable to other applications. The selection of NGI applications is an iterative process with Federal, academia, and industry participation. Applications will be derived from the Federally focused applications in appropriate technology classes, e.g., digital libraries, remote operation of medicine, environment, crisis management, manufacturing, basic sciences, and Federal information services.

This joint agency effort will be coordinated among the participating agencies. Since most of the funding for applications will come from the applications themselves, leadership will be provided via domain-specific affinity groups. Participation will be encouraged from a broad spectrum of agencies with demanding networking applications. Applications will also be solicited from other interested research entities within academia and industry.

## NASA's Role in the Next Generation Internet Program

The NASA Research and Education Network (NREN) is NASA's cornerstone project of the interagency Next Generation Internet and serves the NASA community under this umbrella. NASA's role is to deploy the advanced network technologies required by high performance mission applications in a manner that satisfies the immediate needs of the researcher while simultaneously guiding commercial infrastructure development for the nation.

Specifically, NREN's requirements fall into the following categories: Grand Challenges, NASA mission programs with high bandwidth applications, and national network infrastructure requirements.

NREN's vision is to enable next-generation network applications through a balanced program of network research and research networking.

Collaborative groups, including discipline scientists, software and systems engineers, and algorithm designers will be supported by shared computational and experimental facilities, including professional software development teams, and will be linked by the NGI. Experimental facilities, referred to as "testbeds," will be available and accessible through the NGI to provide real-time access to data streams and support for rapid validation of computational models.

## Information Needed for NGI Evaluation

1. Description of application(s) that will use the wide area network.
2. Can these applications run on the existing Internet? If not, why not?
3. What are the network characteristics of your application? What network services do you need to enable your application (e.g., bandwidth, security, class of service, guaranteed delivery, low latency, etc.)?
4. Is your institution currently an NGI participating site?
5. With what sites will you be communicating?

## How to Apply to Be an NGI Partner

The Astrobiology CAN proposal will also be recognized as a NASA NGI proposal for all who apply. NREN/NGI will support NASA Headquarters in the review of proposals and subsequent network engineering for awardees. However, for advanced networking:

- Universities applying to the CAN must also apply to the NSF High Performance Connections program (see http://www.vbns.net).
- NASA centers applying to the CAN will be handled by the NREN/NGI project and the Astrobiology Institute (see http://www.nren.nasa.gov).
- Other Federal laboratories applying to the CAN must work through their agency sponsor (DoE, DoD, NOAA, NIH, etc) and the NREN/NGI project office to achieve interconnection to the Institute.

## Appendix B: Instructions to Offerors

**B.1** NASA's Grants and Cooperative Agreement Handbook is available through the Internet at: http://procure.msfc.nasa.gov/grcover.htm

**B.2** Prepare the budget according to the form on the following page.

**NO FORMS FOLLOW FOR THIS DRAFT**